Exploring impacts and effectiveness of the City of Cape Town's interventions on household water use practices during the drought

by

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DECLARATION

I, PHIKOLOMZI MATIKINCA, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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DEDICATION

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ABSTRACT

The occurrence of water crises in many parts of the world raises the need to consider more efficient and sustainable consumption of water resources. As such, many cities have prioritised water demand management strategies, which are based on price and non-price mechanisms. The literature shows no consensus as to which of these measures are most effective for managing residential water demand. To understand the impact and effectiveness of these mechanisms, there is a need to understand how people respond to them. This requires understanding materials, meanings and competences (skills and know how) that people have, which constitute elements of social practice. In 2017 and 2018, the City of Cape Town (CoCT) ramped up their price and non-price mechanisms to encourage people to save water in response to a severe drought. These mechanisms included water restrictions, increased water tariffs, and the Day Zero communication campaign. However, little is known about how effective these measures were at encouraging people to save water. There is no clear documentation of how the public understands, interprets and incorporates these mechanisms into their own household water use practices. This study explores the impacts and effectiveness of the City of Cape Town's price and non-price mechanisms on household water use practices during the water crisis. Using information obtained through semi-structured interviews with 20 individuals living in houses where they paid their water bills, a version of social practice theory is used as a lens to understand how respondents interpreted and responded to these mechanisms when it comes to residential water use practices. This allows for an assessment of which of the CoCT's actions are more effective in achieving sustainable water use practices. Results show that price mechanisms (water tariffs) were considered to be ineffective and did not encourage people to save water. Non-price mechanisms (water restrictions and Day Zero communication campaign) were seen as having more impact on respondents, encouraging water conservation behaviour; especially when it comes to household indoor water use activities related to hygiene. Compared to other studies which have used estimates for the water demand function, this study conducted interviews directly with households on the impact of the mechanisms. This enabled this study to explain how and why household water use practices change in response to these measures. Such qualitative information is important and contributes to a field that often uses quantitative data to suggest whether price or non-price mechanisms are effective.

Keywords: Water demand management, Water restrictions, Water tariffs, Day Zero, Cape Town drought, Water use practices, Social practice theory.

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CoCT	City of Cape Town
SPT	Social Practice Theory
WDM	Water Demand Management
WMD	Water Management Device

CHAPTER ONE: INTRODUCTION

Water crises, defined as the lack of sufficient and unpolluted water resources within a region to meet water consumption demands (Conserve Energy Future, 2018), have become an unequivocal reality for some cities around the world. This is due to the occurrence of drought and increased water demand for consumption, alongside growing urban populations. This has also been exacerbated by other factors such as the lack of maintenance of infrastructure for water supply, changing climate and political intransigence, just to mention a few (Swyngedouw, Kaïka & Castro, 2002; Bakker, 2013a,b). To provide some examples; some of the Australian cities such as Brisbane, Melbourne and Perth found themselves at the centre of the so called millennium drought (1996-2010), leading to low levels of water supply to meet water demand for different sectors due to variations in conditions exacerbated by climate change (Fitzgerald, Stanford & Khan, 2014; Lindsay & Supski, 2017). In Brazil, the Northeast region experienced one of the most severe droughts for two years in the late 1990s, resulting in the declaration of state of emergency for 1200 municipalities, while an estimate of 10 million were left vulnerable after their access to food and drinking water was compromised (Kenny, 2002; Bedran-Martins & Lemos, 2017). In 2014-2015, the city of São Paulo in the Southeast region also found itself on the edge of a water crisis driven by drought and political intransigence which led to reduced water supply (Millington, 2018).

In response to water shortages, city governments have to establish ways to deal with low water supply while sustaining the full functioning of the city. Many cities have prioritised water demand management (WDM) strategies, which include price mechanisms (water tariffs) and non-price mechanisms (often including water restrictions and education and awareness raising campaigns) (Willis et al., 2011; Hughes, Pincetl & Boone, 2013; Stavenhagen, Buurman & Tortajada, 2018). These are policy variables prioritised to curb water demand in light of other factors that are reported to influence consumption at household level such as socio-demographic variables (household size, gender, education level and attitudinal variables), environmental variables (temperature and precipitation) and household economic variables (income and available technology - i.e. water-saving plumbing fixtures) (Hanke & de Mare, 1982; Jones & Morris, 1984; Vickers & Markus, 1992; Jorgensen, Graymore & O'Toole, 2009).

There is no clear consensus in the literature as to which mechanisms (price or non-price) are most effective for the management of residential water demand. Araral & Wang (2013) claim

that price mechanisms are the most common water conservation measures for urban water demand management. These strategies, according to Asci, Borisova & Dukes (2015), give households the freedom to decide the nature of changes in water use in response to the increase in prices. In this regard, households can be aware of how much water they use through their water bills and decide to adjust to low-cost water use practices in order to minimise their private costs associated with water consumption (Asci, Borisova & Dukes, 2015). However, the effectiveness of price mechanisms for water conservation mostly depends on the price elasticity of water demand, which refers to how much effect changes in price have on people's water use practices (Tsai, Cohen & Vogel, 2011; Asci, Borisova & Dukes, 2015; Stavenhagen, Buurman & Tortajada, 2018). This price elasticity, in turn, is highly dependent on factors such as seasonal weather conditions or household characteristics, to mention a few (Asci, Borisova & Dukes, 2015).

Olmstead & Stavis (2009) argue that an increase in water tariffs is generally more cost-effective compared to non-price mechanisms such as water restrictions for a given water conservation goal. However, there are still debates regarding their efficacy in terms of bringing about change towards more sustainable water consumption practices (Asci, Borisova & Dukes, 2015). For example, there is a view that adjusting the price of water to that which reflects the true value of producing it, is an effective tool to manage the demand for water because consumers are assumed to adjust their consumption practices according to price changes (Herbertson & Tate, 2001; Olmstead & Stavis, 2009; Araral & Wang, 2013; Asci, Borisova & Dukes, 2015; Stavenhagen, Buurman & Tortajada, 2018). Others argue that water tariffs do not effectively control demand due to the inelasticity of residential water demand to price because the money spent by households on water is relatively small compared to the typical household budget and most water uses cannot be easily substituted (Gaudin, Griffin & Sickles, 2001; Garcia & Reynaud, 2004; Reynaud, 2013).

Non-price mechanisms have recently been considered for WDM (Tortajada et al., 2019). There are not many studies that have placed an in-depth focus on their efficacy. These mechanisms place a direct control over water use through rationing or relying on changing people's habits, rather than affecting the price of the water (Reynaud, 2013). They include water restrictions, prohibition of certain water uses, community mobilisation, education and awareness raising campaigns, as well as making use of technical and engineering mechanisms such as leak-detection instruments, constant-flow meters and pressure-reducing valves (Kenney et al., 2008; Araral & Wang, 2013; Reynaud, 2013). While there is increasing support for these mechanisms

in the literature, and are often implemented together with price mechanisms, it is important to understand how each of them affects water consumption behaviour (Syme, Nancarrow & Seligman, 2000; Araral & Wang, 2013).

The debate around the price and non-price mechanisms for WDM is largely documented in the economic literature. Some authors have looked at direct comparisons between these two types of mechanisms in terms of their effectiveness to result in reduced residential water consumption and found varied impacts (Martínez-Espiñeira & Nauges, 2004; Kenney et al., 2008), while some concluded that price mechanisms are more cost-effective tools than non-price mechanisms for WDM (Olmstead & Stavis, 2009). However, Reynaud (2013) argues that comparing the effectiveness of price and non-price mechanisms for residential water consumption is difficult to undertake because of two main reasons. First, it is difficult to evaluate their effectiveness individually as these usually interact in fostering water conservation (Syme, Nancarrow & Seligman, 2000; Reynaud, 2013). Second, education and awareness raising campaigns have the potential to serve as motivation for people to respond to price mechanisms but if such motivation is not properly understood, it is likely that changes in residential water use will always be incorrectly attributed to price mechanisms (Reynaud, 2013).

Taking the above into consideration, the lack of clear consensus regarding the suitability of these mechanisms to curb water demand extends to their efficacies. Some authors argue that these are most effective when they are implemented together to support each other (e.g. Kenney et al., 2008) while others such as Syme, Nancarrow & Seligman, (2000) and Reynaud (2013) note the difficulties of evaluating the effectiveness of these mechanisms when they are implemented together because one could easily overshadow the other. Moreover, most of these studies are based on pre-existing quantitative data that have been used to model changes in water consumption to measure the impact and effectiveness of water conservation mechanisms. None of the studies mentioned have engaged with the nature of changes in residential water use and motivations behind maintaining certain household responses to these mechanisms.

Therefore, to understand the impact and effectiveness of these mechanisms, there is a need to understand how people respond to them in the real world as opposed to modelled behaviour. This requires understanding materials, meanings and competences (skills and know how) that people have, which constitute elements of social practice. In social practice theory (SPT) practices are defined as “a routinised type of behaviour which consists of several elements,

interconnected to one another: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (Reckwitz, 2002: 249). Gaining insights about people's social practices, especially water use practices, can help improve the implementation of water conservation mechanisms which can result in positive changes in water use behaviour (Kadibadiba, 2017).

In 2017 and 2018, the metropolitan municipality of the City of Cape Town (CoCT) in South Africa ramped up its price and non-price mechanisms (hereafter referred to as CoCT's actions) to encourage people to save water in response to the drought that had started in 2015 (CoCT, 2018; Ziervogel, 2019). These measures included enforcing water restrictions and water tariffs, installing water management devices that keep household consumption below a set level, and establishing a water conservation campaign which included information about the threat of "Day Zero" (when domestic taps would be completely turned off unless consumption was reduced) (CoCT, 2018; Ziervogel, 2019). However, little is known about the impact and effectiveness of these measures and how they have landed in practice in terms of residential water demand, especially during the final stages of the crisis in 2018 (Booysen, Visser & Burger, 2019). There is a need to document how the public understands, interprets and incorporate these mechanisms into their own household water use practices and build knowledge about which of these interventions encourage people to save water most. This is relevant both for policymaking in Cape Town and cities facing similar challenges, and in order to inform research around the impact and effectiveness of price and non-price mechanisms noted earlier.

As such, this study focuses on price and non-price mechanisms implemented by the CoCT in response to the drought that were intended to get residents to reduce their water use. The focus is on exploring the meanings and interpretations that household water users attributed to the different measures the CoCT used and how these measures might have impacted on household water consumption practices. To do this, the study draws on components of social practice theory as a lens to understand how different households utilised the measures introduced by the CoCT in relation to their water use practices. The use of social practice theory will help to understand the gap between people's understanding and interpretations of the CoCT's actions and how these might have influenced the way people use water. When drawing on a social practice lens, the CoCT's actions are regarded as materials for intervention, people's

interpretations and understanding of these measures constitute meanings and how they responded to these actions in terms of their water use practices forms part of competences.

1.1. Aim and objectives

The aim of this study is to explore how the City of Cape Town's actions during the water crisis impacted on households' water use practices. To fulfil this aim, the study will address the following objectives:

i) Explore households' understanding of the CoCT's actions, and what they were and when they were implemented.
ii) Develop an understanding of the meanings and interpretations attached to, and the effectiveness of, the CoCT's actions for household water users.
iii) Document the nature of, and motivations behind, household responses (in terms of how they use water) to the CoCT's actions.
iv) Explore drivers and motivations for maintaining and/or discontinuing the new behaviour in terms of certain water use practices.

1.2. Thesis outline

This thesis is made up of eight chapters. The introduction chapter provides a theoretical background, the rationale and aim and objectives. This is followed by a second chapter on the review of the literature based on debates around the impact and effectiveness of price and non-price mechanisms. The third chapter sets the context and focus of the study and is based on the City of Cape Town's actions for managing water crisis. Chapter four details Social Practice Theory as a lens used for analysis in this study. The fifth chapter gives a detail of the methods used, including ethical considerations. Chapter six presents findings based on the understanding of the timeline and the nature of the CoCT's actions, meanings and importance of these actions, household responses and drivers and motivations for maintaining and/or discontinuing the new behaviour in terms of certain water use practices. Chapter seven discusses the results and provides an analysis. The last chapter presents the conclusions and recommendations of the study.

CHAPTER TWO: LITERATURE REVIEW

The occurrence of drought in different parts of the world has resulted in city governments implementing water conservation measures as means of intervention to foster sustainable water use during the times of water crises. Previous studies have made evaluations of the effectiveness of these interventions using a range of approaches. However, most of these approaches have been based on quantitative statistical modelling, using pre-existing municipal data on water use, rather than engaging with households to understand the impact of these interventions on water use practices (Kenney et al., 2008; Araral & Wang, 2013; Reynaud, 2013). For example, a statistical model was developed in 1992, decomposing water use into base use and seasonal use, and was applied over Los Angeles to measure responses to drought on municipal weekly water use in 1990-1991, with good model performance (Shaw, Henderson & Cardona, 1992). This model was later used in Colorado to determine impacts of water restrictions by comparing reductions in water use prior and during the period of restrictions (Kenney, Klein & Clark, 2004).

Currently, there are not many studies that have documented cities' interventions in response to drought. Regarding those that have, most reported on water restrictions and water tariffs. For example, some of these studies have showed that water restrictions have been implemented by cities such as Colorado (Kenney, Klein & Clark, 2004), Cape Town (Jacobs et al., 2007), Southeast Florida (Survis & Root, 2012), Los Angeles (Mini, Hogue & Pincetl, 2014) and some cities in Australia (Haque et al., 2013; Lindsay & Supski, 2017). Of these studies, all but one used modelling to quantify the effectiveness and impacts of water restrictions on water consumption (Kenney, Klein & Clark, 2004; Jacobs et al., 2007; Survis & Root, 2012; Haque et al., 2013; Mini, Hogue & Pincetl, 2014). None of these studies, however, engaged with individual households in exploring the impact of interventions on how water is used and how these interventions are interpreted and understood by the public. Using different models, quantification from these studies showed that indeed all but one of the cases had water restrictions that had positive impacts, leading to the reduction of water consumption. The one exception was the city in which Survis & Root (2012) showed that water restrictions were ineffective and instead, water consumption increased during the "restrictions" period in the Gold Coast region in Australia. The one study that did not use modelling by Lindsay & Supski (2017) undertook a qualitative approach using focus groups to explore how household water use practices changed during the drought, using water restrictions as a 'material' for

intervention. This study reported that in Brisbane and Melbourne participants asserted that water restrictions played a significant role because they made households change the way they use water, shifting towards more sustainable water use practices (Lindsay & Supski, 2017).

According to Sahin, Bertone & Beal (2017), households consuming large volumes of water have to deal with a higher marginal cost of water utility, while those using less water pay a proportionally less amount. This is because with marginal cost of water, the more people use water is the more they need to pay (Sahin, Bertone & Beal, 2017). Therefore, water tariff (such as pricing) is an intervention that offers a potential management solution for city governments to find the balance between demand for, and supply of, water (Sahin, Bertone & Beal, 2017). Droughts have caused some cities to change their water tariffs, for example, in Israel (Becker, 2015; Molinos-Senante & Donoso, 2016), and in water scarce regions of Mexico (Guerrero-Garcia-Rojas, Gómez-Sántiz & Rodríguez-Velázquez, 2015).

In some places, including South Africa, water is considered to be a basic right which everyone, regardless of their background and material conditions, should have access to (Thompson, Masiya & Tsolekile De Wet, 2013). As such, increasing water tariffs is often controversial when it impacts low income groups, who often already spend a higher proportion of their income on water compared to middle to high income groups (Barrett, 2004; Inman & Jeffrey, 2006). This is due to the challenges faced by the management of water resources relating to equity, justice and fairness (Thomas & Twyman, 2005). One of the major concerns is that, impacts of water demand management policies and water conservation are often inequitable at the local level because they tend to not consider social and economic conditions of poor communities (Francis, 2005; Mahlanza, Ziervogel & Scott, 2016). Moreover, some authors have raised concerns regarding the effectiveness of the billing system in encouraging people to save water around their homes. For example, the use of billing information to analyse the water usage patterns has been found problematic as the reading of water meters only occurs on a monthly basis, thereby hiding most of the transient effects that may last for a short period of time, maybe for a day or a week (Rein, Champanis & Rivett, 2013). This raises challenges for demand side management because achieving water usage target in this instance is highly dependent on the user manually accessing the water meter, frequently making readings and interpreting them in a meaningful way (Rein, Champanis & Rivett, 2013; Booysen, Visser & Burger, 2019). Therefore, if the user does not do all these things and depend on the monthly reading of the meter, they might miss some of the useful information that could help in saving water in their households on a daily basis. In Pietermaritzburg, KwaZulu-Natal, Smith & Green

(2006) found that meter readings are one of the factors that have led to confusion and distrust towards the municipality. This is because people had no understanding of how the water meter works, did not trust the work of the person responsible for reading the meter and had problems checking whether the amount of money they were paying for water was realistic and true reflection of their usage (Smith & Green, 2006). This, according to Rein, Champanis & Rivett (2013), shows that people may not even be aware of, or have knowledge to understand where they belong in the water systems, as far as their position is concerned.

However, others argue that increasing the price of water can have positive impacts on low income households as these may result in more sustainable water consumption practices, reductions in water demand and more efficient water allocation that would lead to higher returns (Rogers, De Silva & Bhatia, 2002; Olmstead & Stavis, 2009). Moreover, Willis et al. (2013) state that block pricing (where households pay different amounts of money for different consumption levels, usually meaning that high volume users pay more per unit of water than low volume users) is one of the strategies to cater for low income groups in water tariff systems. Block tariffs are one way of financing a free basic allowance for low income households, by making those whose consumption goes above average pay a premium (Willis et al., 2013). In South Africa, a special report on cost recovery, cut-offs, and the affordability of municipal services reported that the block price strategy received considerable support from survey respondents, regardless of income status, urban or rural location, and ethnicity (McDonald, 2002). In São Paulo, Brazil, an analysis of water pricing revealed that increasing block pricing had positive impacts on low income households, while a flat price had positive impacts for high income households (Ruijs, 2009).

Other interventions that came up in the studies include the provision of subsidies for water saving appliances such as rainwater tanks in Australia (Lindsay & Supski, 2017), water distributions in the Northeast region of Brazil (Bedran-Martins & Lemos, 2017), pressure reduction in water pipes in São Paulo (Millington, 2018), news releases through media in Flint (Logan, 2018), educational programmes (Campbell, Johnson & Larson, 2004), and technological changes in water use devices such as washing machines and showerheads (Michelsen, McGuckin & Stumpf, 1999). Not all these studies were based on how these interventions impacted on residential water use. For example, in Flint, Logan (2018) reported that the media campaigns were just a way of dissociating the government from the water crisis and shifting the blame and responsibility towards the citizens. On the other hand, educational programmes have the potential to result in positive impacts if they are implemented for a long

period of time (Michelsen, McGuckin & Stumpf, 1999; Campbell, Johnson & Larson, 2004). In terms of understanding the effectiveness of technological changes, Michelsen, McGuckin & Stumpf (1999) state that most studies have been based on engineering assumptions when it comes to expected reductions. An exception is a study done in California, which found that residential water consumption decreased by 10% per toilet due to the installation of low-flow toilets (Renwick & Archibald, 1998). Some authors suggest that, to achieve better results for demand side management of water resources, some of these measures must be implemented together than focusing on one measure at a time. In the US state of Texas it was reported that water usage restrictions and education and awareness raising campaigns would achieve a better result for demand side management than focusing on incentives that are provided for water conservation technologies (Dascher, Kang & Hustvedt, 2014).

Given the debates around the impact and effectiveness of price and non-price mechanisms, it is also important to note that empirical research shows that domestic water consumption is also influenced by numerous variables. These include socio-demographic factors (household size, gender, education level and attitudinal variables), environmental variables (temperature and precipitation) and household economic variables (income and available technology - i.e. water-saving plumbing fixtures) (Hanke & de Mare, 1982; Jones & Morris, 1984; Vickers & Markus, 1992; Jorgensen, Graymore & O'Toole, 2009; Shan et al., 2015). Some of the first studies looking at factors that influence water consumption concluded that rainfall, price mechanisms, income and household size are some of the primary determinants of domestic water demand (Darr, Feldman & Kamen, 1975; Forster & Beattie, 1979; Renwick & Archibald, 1998). A cross country analysis report based on a survey in ten countries (Australia, Canada, Czech Republic, France, Italy, Korea, Mexico, Netherlands, Norway and Sweden) shows that educational level, household size and income had positive and significant effects on household water consumption (Grafton et al., 2009).

In Cape Town, a few studies have sought to examine water users' responses to the recent drought. Of these studies one is a peer-reviewed journal article (Booysen, Visser & Burger, 2019), two are draft working papers (Brick & Visser, 2018; Brick, Demartino & Visser, 2018) and then two web pages (Kohlin, Whittington & Visser, 2018; Visser & Bruhl, 2018). Using smart meter data to study household behavioural responses to the possible occurrence of Day Zero, Booysen, Visser & Burger (2019) show that social media coverage of the drought and the release of the CoCT's Critical Water Shortages Disaster Plan in October 2017 resulted in most dramatic changes in behaviour. However, due to contradictions in communication from

national and provincial government, some of these changes got eroded (Booysen, Visser & Burger, 2019). During the early stages of the drought, between November 2015 and May 2016, domestic households received messages through letters (Brick, Demartino & Visser, 2018) and this was subsequently followed by a campaign of warning letters in March 2017, sent to households whose water consumption was more than 50 kilolitres per month (Brick & Visser, 2018). A take home message from these studies is that, behaviour can be changed. But, since these studies are quantitative, it is not known why behaviour can be changed. By using qualitative interviews, this study is better positioned at answering this "why?".

Given the context of the literature discussed above, there is a need for more research to engage households in identifying how they respond to government interventions during the water crises. As the review of the literature showed, most work on interventions, such as water restrictions, has been based on the use of pre-existing municipal data to model how water consumption decreases when water restrictions are in place. There is a need, however, to also gain insights on how households understand and interpret these interventions, and their impacts on residential water use practices. Currently, most of the literature goes as far as reductions in water use during the drought are concerned. This does not provide insights on the importance of the interventions for households and the detail of the nature of changes in water use practices in response to the government interventions. Therefore, these gaps provided a rationale and points of interest for this study.

CHAPTER THREE: CoCT's ACTIONS FOR MANAGING WATER CRISIS IN CAPE TOWN

Cape Town, situated in the Western Cape Province of South Africa, has experienced the driest 3-year period (from 2015 to 2017) in the catchment area since rainfall measurements started in the 1930s. Such periods occasionally occur naturally, once in every few hundred years (Wolski, 2018). However, research indicates that water crises are becoming more likely to occur due to climate change, droughts, increasing population, changing political landscapes and increases in consumption demand (Swyngedouw, Kaïka & Castro, 2002; Bakker, 2013a,b). When the water crisis occurred in 2015, prolonging to 2017 and 2018, it placed enormous pressure on the city's water supply, which is mainly based on six dams that supply water for approximately four million Cape Town inhabitants (Sorensen, 2017; Booysen, Visser & Burger, 2019).

In response to the intensification of the drought, the CoCT gradually undertook several actions to reduce water consumption. Such actions were implemented over a period of time. For example, there were several different levels for water restrictions coupled with water tariffs, and the Day Zero communication campaign went on for some time (November 2017 – March 2018). Table 1 below provides a timeline of when the CoCT undertook each of these actions in response to the drought, and changes that happened throughout 2016 to 2018, depending on the severity of water crisis in Cape Town.

The CoCT had water restrictions in place since 2016, with level 3 restrictions prohibiting the use of tap water for hosepipes in gardens, washing cars and sprinkler irrigation (Booysen, Visser & Burger, 2019). On 22 May 2017, the Western Cape Government (WCG) declared the Western Cape Province a disaster area due to the severity of the drought (WCG, 2017). On 1 June 2017, level 4 restrictions aimed to limit each user to 100 L/person/day and prohibit all non-essential outdoor water use activities such as filling the swimming pools with municipal water (CoCT, 2017a). A month later, this was followed by level 4B restrictions put in place to reduce daily water usage to 87 L/person/day and allow for 10.5 kL/month water allocation for households based on the per-person usage of a household of four over 30 days (CoCT, 2017b; Booysen, Visser & Burger, 2019). On 17 August 2017, the mayor of the CoCT made an announcement that the Water Resilience Plan was officially put in place (Booysen, Visser & Burger, 2019). Included in this plan were the fines and punitive measures for heavy water users, possibility of ramping up water restrictions, plans for water augmentation programmes and the installation of devices to restrict high water use at the expense of householders at non-

complying properties (CoCT, 2017b; Booysen, Visser & Burger, 2019). Following the plan, the CoCT ramped up water restrictions to level 5 on 3 September 2017, thereby including more fines and announced that it would begin the management of water pressure to reduce losses caused by water leakages (GreenCape, 2018; Booysen, Visser & Burger, 2019). However, there was a bit of confusion with level 5 restrictions because they came with two conflicting requirements; one part was similar to level 4B restrictions (87 L/person/day with the implication that a household of four people would use 10.5 kL/month) (GreenCape, 2018) and the other part capped residential properties at 20 kL/month (Booysen, Visser & Burger, 2019). Booysen, Visser & Burger (2019) speculate that maybe the CoCT put forward the 20 kL/month to be more lenient on, or accommodate, low income properties that have larger household sizes. This was, however, not clearly communicated or explained thus sent a mixed message to most households with average size (3.50 persons according to the city's 2011 census) (CoCT, 2011), who were already using 10.5 kL/month or less (Booysen, Visser & Burger, 2019). On 4 October 2017, the Critical Water Shortages Disaster Plan was released by the mayor of the CoCT and table 2 shows some of the points that the plan put forward (Booysen, Visser & Burger, 2019).

In 2018, the severity of the water crisis meant that the CoCT needed to act with urgency in encouraging sustainable water use practices, thereby implementing measures for water conservation. These included level 6 and level 6B water restrictions, increase in water tariffs, pressure reduction, household flow regulators and information to encourage behaviour change (CoCT, 2018). Household flow regulators included the installation of water management devices (WMD) to monitor household daily water use and safeguard against the impact of leaks (CoCT, 2018). These WMD were only installed in households using more than 10.5 kL/month of water consumption (CoCT, 2018). Pressure reduction has been accelerated by the CoCT to automate zones for the optimization of the water supply system, reducing demand and minimizing the impact of leaks (CoCT, 2018). The CoCT implemented level 6 restrictions on 1 January 2018 to maintain the 87 L/person/day limit and emphasised on the 10.5 kL/month for a household, as well as imposing fines on households whose usage was exceeding the stated cap (Booysen, Visser & Burger, 2019). Level 6B water restrictions came into place on 1 February 2018 as a means to reduce daily consumption target to 450 million litres per day (MLD) (CoCT, 2018). With this target in mind, individual water use was restricted to a maximum of 50 L/person/day so that 4 million people at 50 L/person/day would result in 200 MLD (CoCT, 2018). Of the remaining 250 MLD, 150 MLD was to be consumed by the government, commerce and industries (CoCT, 2018). This would then result in 100 MLD less

than the daily target of 450 MLD (CoCT, 2018). Included in these restrictions was also the prohibition of certain water use practices such as gardening, outdoor pools, and washing cars with municipal drinking water (CoCT, 2018). Level 6B tariff came into effect in February 2018 with the aim of charging more for the use of high volumes of water (CoCT, 2018). A communication campaign took place through radio, print and social media, essentially reaching out to citizens and mobilising for the reduction in water consumption to the 450MLD target, as well as encouraging people to use less water and stay below the water restrictions (CoCT, 2018). Central to this campaign was the possibility of the occurrence of Day Zero, when the city's domestic taps would be completely turned off unless consumption was reduced. After numerous estimations of the date for the arrival of Day Zero (e.g. 21 April, 11 May, 4 June, 9 July, 15 July) as shown in the drought timeline by GreenCape, Day Zero was cancelled in March as the CoCT announced that this was unlikely to occur in 2018 (GreenCape, 2018). In addition to these measures, the CoCT tried to encourage behaviour change using star rating tool for buildings and providing visual availability of household water consumption data (through dark green and green dots) in incentivising all households to limit their usage (CoCT, 2018).

Drawing from the range of actions taken by the CoCT, this study focuses on three, namely, water restrictions, water tariffs, and the awareness raising and communication campaign around the possible occurrence of Day Zero. This is because, unlike other actions, these three were applicable to every household in Cape Town, except for indigent households who get municipal water from the CoCT without having to pay for it. Moreover, as noted earlier, not every household had a WMD installed in their home.

Table 1: Timeline of the CoCT's responses to the water crisis in Cape Town (GreenCape, 2018; Booysen, Visser & Burger, 2019).

Date	CoCT's responses to the water crisis
2016	
01 January 2016	Level 2 water restrictions
01 November 2016	Level 3 water restrictions
2017	
01 February 2017	Level 3B water restrictions (Target was 800 MLD for the city)
22 May 2017	Western Cape declared a disaster area
01 June 2017	Level 4 water restrictions
01 July 2017	Level 4B water restrictions
30 July 2017	Day Zero to refer to Cape Town water crisis (used by Western Cape Premier: Helen Zille)
17 August 2017	Water Resilience Plan released
03 September 2017	Level 5 water restrictions (Target of 87 litres per person per day)
04 October 2017	Critical Water Shortages Disaster Plan released
November 2017	The concept of Day Zero officially adopted by the CoCT
2018	
01 January 2018	Level 6 water restrictions
12 January 2018	Day Zero estimated to be 22 April 2018
18 January 2018	Mayor's announcement that Day Zero was likely to occur
19 January 2018	Day Zero estimated to be 21 April 2018
26 January 2018	Day Zero estimate to be 12 April 2018
01 February 2018	Level 6B Water restrictions (Target of 50 litres per day) (punitive water tariffs for water users using above 10.5 kL of water)
02 February 2018	Day Zero estimated to be 16 April 2018
05 February 2018	Day Zero estimated to be 11 May 2018
16 February 2018	Day Zero estimated to be 04 June 2018
23 February 2018	Day Zero estimated to be 09 July 2018
02 March 2018	Day Zero estimated to be 15 July 2018
07 March 2018	Day Zero **cancelled** for 2018
21 July 2018	New Tariffs for 2018/2019, which include a fixed as well as consumptive charge

Table 2: Some of the points raised in the Critical Water Shortages Disaster Plan, released 4 October 2017 (DeLille, 2017; Booysen, Visser & Burger, 2019).

Relevance	Description
General	Winter, the rainy season, was over and users were in for a long, hot, dry summer period.
	27% usable water was left in the dams
	Cape Town was expected to run out of water by March 2018.
	The national Minister of Water and Sanitation [importantly, from the African National Congress (ANC), the opposition to the governing Democratic Alliance (DA) in the in the Western Cape] had been engaged to discuss water security and new emergency schemes.
Phase 1	This phase was immediately active
	Water rationing through extreme pressure reduction would be introduced, which would lead to intermittent, localised temporary water supply disruptions.
	Users were advised to store up to 5 L of municipal drinking water only for essential usage.
Phase 2	The whole system would be disrupted with a limited number of supply points.
	Water collection points would be put up.
	The defence force (SANDF) and the police service (SAPS) would be deployed to ensure that general safety was maintained throughout the city.
	Critical services, and areas with an increased risk of disease and fires, would continue to receive drinking water.
Phase 3	The existing system would collapse

CHAPTER FOUR: CONCEPTUAL FRAMEWORK

The study drew from a version of social practice theory (SPT) which puts emphasis on the collective and routine features related to consumption and seeks to explore the interaction that occurs between elements of social practice (Pullinger et al., 2013; Browne, 2015; Maller, 2015; Lindsay & Supski, 2017). The SPT argues that while individuals carry practices, they do not only carry patterns of bodily behaviour, but also ways of understanding, knowing how and desiring that they have routinised overtime (Reckwitz, 2002).

Shove, Pantzar & Watson (2012) argue that the enactment of social practices forms as a result of integration between three elements: materials, competences and meanings. Materials refer to things, consumer goods, tangible physical entities, technologies, and the stuff that makes up objects; competences include know-how, understandings of the situation, skill and technique; and meanings encompass ideas, understandings of the social significance of the practice, symbolic meanings and aspirations (Shove, Pantzar & Watson, 2012). These elements interact and combine to precipitate out the 'bundle of activities' that occur in everyday social practices such as how water is used for showering (Lindsay & Supski, 2017). Therefore, the relationship that occurs between the socio-technical elements that form habits and social practices becomes an important aspect (Lindsay & Supski, 2017). For example, when watering the garden, hosepipes and water taps constitute objects (materials) used for carrying out the practice. Choosing to not water the garden regularly or using buckets instead of hosepipes to save water during the drought forms part of competences (skills and know how). And how different people perceive the garden as either a place to relax after a long day, a place where plants and vegetables are grown or a place where water use can be reduced during the drought, constitutes meanings that people attach to the garden.

According to Lindsay & Supski (2017), SPT uses practices as the unit of analysis and intervention when engaging with the relational interplay between materials, competences and meanings rather than trying to individualise behaviours or choices. In doing so, the SPT seeks to move away from individual behaviours by focusing on practice 'entities' in order to avoid shifting the blame to individuals for their 'choices', such as the unsustainable water use in households (Hargreaves, 2011; Lindsay & Supski, 2017). Moreover, concentrating only on individuals as primarily responsible for the occurrence of changes on the levels of sustainable resource consumption, in this case water consumption, leads to the risk of missing larger scale changes that may be required for fostering sustainable balance between resource consumption

levels and the capacity of the planet (Kuijer, 2014). As such, the principal implication of SPT, as noted by Warde (2005), considers the development of practices themselves as the primary sources of behaviour change. In this case, anti- or pro-environmental behaviours, and sustainable and/or unsustainable levels of resource consumption, are not perceived as products of individual's values, beliefs and attitudes constrained by various contextual 'barriers', but as aspects lodged within and taking place as part of social practices (Ward, 2005; Hargreaves, 2011). When these practices are performed they then become part of accomplishing routines of what people regard as 'normal' ways of life (Shove, 2003a; Hargreaves, 2011).

Social practice theory thus shifts the focus from individual decision making towards the 'doing' of social practices and the inconspicuous consumption entailed in such practices (Shove & Ward, 1998; Hargreaves, 2011; Lindsay & Supski, 2017). As such, SPT puts emphasis on how individuals engage with everyday practices in developing an understanding of the world around them, as well as the sense of self (Ward, 2005; Hargreaves, 2011). This does not, however, regard individuals as passive dupes bound by the dictates of social practice, but instead conceives of them as 'carriers', 'agents' or 'hosts' possessing skills in actively negotiating and performing practices in the course of everyday life (Hargreaves, 2011; Kuijer, De Jong & Van Eijk, 2013; Lindsay & Supski, 2017).

In light of these perceived points of agreement regarding the nature of SPT, it is, however, also important to make note of existing areas of contrasting views amongst theorists. One area, for example, is centred around the exact definition of what a 'practice' is. While Shove & Pantzar (2005) focus on various elements that make up a practice (similar to Reckwitz's definition noted earlier), others put emphasis on the connections that exist between these components (e.g. materials such as restrictions can influence people's competences in terms of how they use water) (Schatzki, 2002; Ward, 2005; Hargreaves, 2011), and others position practices as a bridge that exists between lifestyles of individuals and social-technical systems of provision (Spaargaren & Van Vliet, 2000).

To provide a simple of example of how SPT works, drawing from Lindsay & Supski (2017), SPT can be used to study showering habits during a water crisis. This involves materials (e.g. low flow showerheads being installed), competences (e.g. taking shorter showers and less frequent showers), and meanings (e.g. showers being perceived to be essential for cleanliness or a place where water use can be reduced). People reproduce and maintain the links between these components when showering in their everyday life (Hargreaves, 2011). When these links

are made, shifted or broken, a change occurs leading to the creation of new practices and new combinations of components (Hargreaves, 2011; Lindsay & Supski, 2017). For example, when the drought became more severe in Cape Town, some people may have decided to stop using showers and use basins for bathing and containers to measure the amount of water used. In such example, materials involved change from showers and showerheads to basins and containers. Competences shift from showering to new ways of doing "bathing using basins" that would allow for grey water recycling. Meanings involve a shift from not only seeing showering as a way to keep clean but also as a place where water can be saved most. Therefore, to generate sustainable consumption practices, there is a need to challenge and break the links and elements of existing unsustainable practices before they are replaced and re-made in more sustainable ways (Hargreaves, 2011). In offering an insight of how this process might occur, Ward (2005) shows that a change occurring in practice emerges from both "inside" as the carriers of practices contest and resist conventions and routines and improvise new ways of doings, and "outside" as the contact between different practices occurs (Ward, 2005).

Using a social practice framework requires understanding the way in which materials (objects), competencies (bodies), and meanings combine (Lindsay & Supski, 2017). According to Kuijer, De Jong & Van Eijk (2013), materials form an integral aspect of understanding practices so that when a practice such as showering, or gardening takes place, it involves the utilisation of objects and an understanding of how materials function or should be used. In this case, objects involved in using water for gardening such as buckets, rainwater tanks, as well as those used in showering (e.g. low flow showerheads) provide opportunities for intervention (Lindsay & Supski, 2017). For the purpose of this study, the CoCT water restrictions, water tariffs, and awareness raising campaigns such as the messaging around Day Zero can be viewed as a 'material' intervention for the regulation of the ability to use water in different households.

Competences also form a necessary integral part of social practices (Wallenborn & Wilhite, 2014). Maller & Strengers (2013) argue that practices are remembered by bodies. Those memories are carried across geographical space and temporalities, often resurfacing later in the life of a practitioner or the next generation (Lindsay & Supski, 2017). As such, practice memory is materially embodied in such a way that it can be called upon to initiate or reignite particular practices (Maller & Strengers, 2013).

In addition to materials, and embodied materiality as competences, meanings constitute the third integral component of social practices (Delaney & Fam, 2015; Lindsay & Supski, 2017).

Looking at the ‘meaning’ behind the household use of rainwater in Australia, Delaney & Fam (2015) outline how meanings of practices can be studied to gain an insight of the nuanced cultural, historical and emotional meanings of water consumption in various households.

Given the context above, this study argues that the CoCT’s actions for curbing water demand provide households with opportunities to reframe their water use practices to introduce new modes of doing which “combine elements differently, that draw on embodied performances and opens up opportunities for new meanings” (Lindsay & Supski, 2017: 53). In doing so, this provides an opportunity for the emergence of new practices and new combinations of components (Lindsay & Supski, 2017) which involve new configurations of existing components or of new elements that occur concurrently with those that already exist (Shove & Pantzar, 2005). As such, given the occurrence of the drought in Cape Town, this study regards the CoCT’s actions (water restrictions, water tariffs and the Day Zero communication campaign) as materials for intervention in the time of a crisis, in addition to materials that different households already have. For example, water restrictions banned the use of hosepipes in watering gardens and washing cars. In this instance, restrictions are materials banning the use of other materials (hosepipes) in performing certain practices (gardening). The argument is that, the CoCT’s actions offer an opportunity for households to evaluate and reconfigure the use of pre-existing materials that they have in carrying out certain water use practices. Moreover, it is argued that these actions may lead to changes in the relationships that exist between materials, competences and meanings. For this to happen, people need to understand and interpret the nature of these actions to be able to incorporate them into their water use practices, and this constitutes meanings. Once people understand and find meanings of these actions, they are able to respond in a certain way in relation to their water use practices, and this forms part of competences.

CHAPTER FIVE: METHODS

5.1. Data collection

The study followed a qualitative approach using in-depth face-to-face interviews to explore how the CoCT's different drought responses impacted on household water use practices. Face-to-face interviews were used because they provide an opportunity to build a relationship between study respondents and the researcher, before and during the interview. This also gave room for a more interactive discussion on views or ideas that came up. This is important because during the interview, emergent ideas or opinions that had not been initially included in the interview questions could be further explored (Mason, 2002).

The study targeted a non-representative sample of 20 households in Cape Town. The reason for choosing this sample size is because this research was not focusing on the spread of opinions or views across a large population which would require a representative sample but sought to conduct in depth interviews to gain insight about people's experiences, interpretations and meanings of the CoCT's actions for water conservation and how they influenced household water use practices. This was also, in part, due to the time constraints for this research as engagement with a representative sample of a large population would require an extended period.

Purposive sampling was used to select respondents to be included as part of the sample. Purposive sampling refers to non-random ways (such as stratified sampling and snowball sampling) that are used to ensure that particular groups or categories of the sample are present, based on the aim and objectives of the study (Robinson, 2014). The rationale for using such a strategy is that, drawing from the theoretical background and gaps identified in the literature, the researcher wanted to include certain groups or individuals in the study because of their different or important experiences and perspectives (Mason, 2002). As mentioned, high consumption of water was considerably costlier in 2018 than the previous years, especially for low and middle to high income households. Therefore, the inclusion of diverse income groups was important in this study.

Stratified sampling was used as the purposive sampling strategy. According to Robinson (2014), this approach allows the researcher to select groups or categories of the sample to be included in the study. Such categories can then be used to stratify the sample accordingly and specify the number of respondents targeted for each category (Robinson, 2014). These categories may refer to demographic, geographical or socio-economic aspects (Robinson,

2014). For this study, the focus was on two groups, namely, low (but above indigent) and, middle to high income households. The target was on individuals who are responsible for paying the water bill, who reside in a free-standing house, had lived at the current address from at least the beginning of 2017 up until the time of the interview, and who are not and do not have family members that are employees of the CoCT municipality (Willis et al., 2013). The respondents were contacted through social networks and some through referrals from other respondents.

5.2.1. Interviews

The interviews were conducted in November and December 2018, during which water restrictions changed to level 5 in November and then to level 3 in December. Households in eight different Cape Town residential areas were identified, including Crossroads, Delft, Dunoon, Joe Slovo Park, Khayelitsha, Kuils River, Observatory and Philippi (Figure 1). These households were included in the study based on their interest to take part in the interviews. These areas are characterised by different socio-economic contexts (Table 3), with Crossroads, Dunoon and Philippi classified in the 2011 Census as low income areas (R1 – R19 200), while the rest of the areas fall into the middle-income category (R19 201 – R307 200) (StatsSA, 2015).

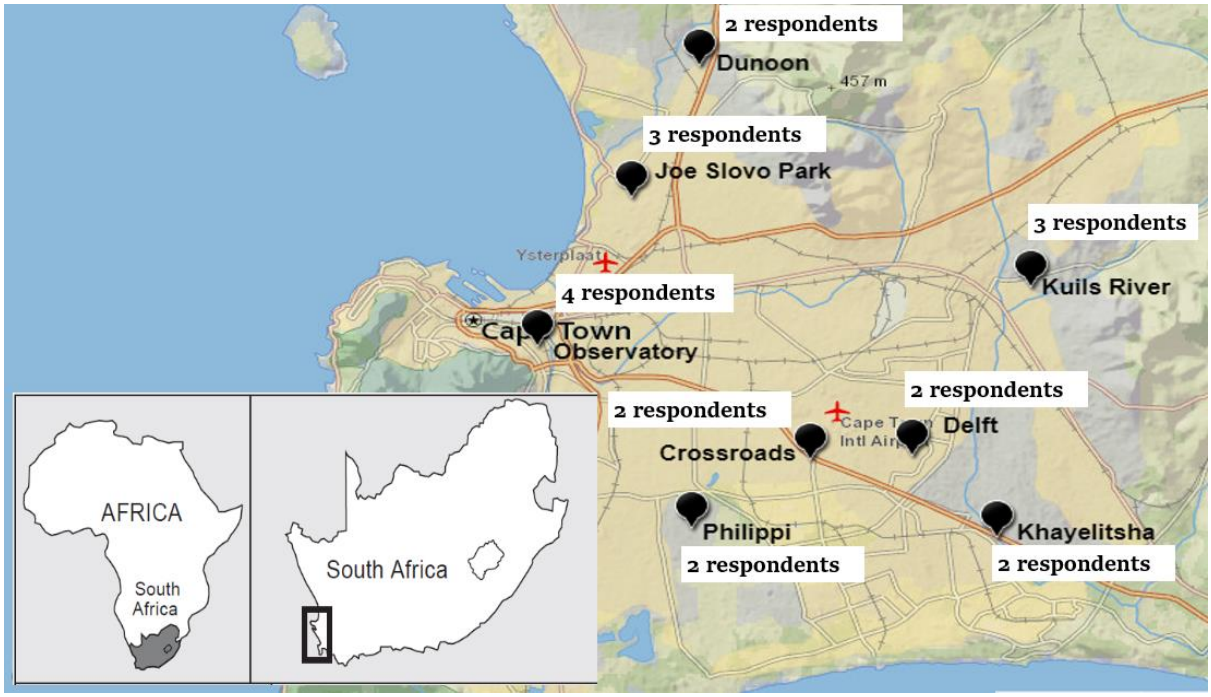

Figure 1: Location of residential areas (shown by the pins) where interviews were conducted.

Table 3: Some information about socio-economic context of the residential areas included (The Census 2011 provides statistics for administrative divisions or wards and not per suburb. Average annual household income is based on median estimates) (StatsSA, 2011).

Suburb	Administrative division	Average annual household income	% of those who completed grade 12 or higher	% of the population employed
Crossroads	36	R14 600	27.1	31.6
Delft	13	R29 400	24.1	39.7
Dunoon	104	R14 600	27	48.4
Joe Slovo Park	4	R57 300	60.9	64.8
Khayelitsha	92	R57 300	55.9	45.4
Kuils River	11	R230 700	62.8	61.2
Observatory	57	R115 100	61.4	45.1
Philippi	80	R14 600	30.5	40.6

The interviews consisted of open-ended questions (appendix 1). The first section of the interview focused on collecting the necessary and relevant demographic information and household characteristics including the total number of people in the household, presence/absence of devices (such as televisions and radio), and some background information on what the household uses most of the water for (Table 4). This information was necessary to record because it can be argued that the number of household members may impact on how much water is used in the household. Television and radio are some of the common devices used to convey messages about current affairs to the public. The remainder of the interview was centred around the objectives of this study, looking at (i) households' understanding of the timeline and nature of the actions taken by the CoCT to encourage people to save water, (ii) the meanings and interpretations attached to, and the effectiveness of, the CoCT's actions for household water users, (iii) the nature of, and motivations behind, household responses (in terms of how they use water) to the CoCT's actions and, (iv) drivers and motivations for maintaining and/or discontinuing the new behaviour in terms of certain household water use practices in response to these actions.

Table 4: Some of the household information relevant for the study ("JoJo Tanks" refer to containers for collecting and storing rainwater).

Suburb	Number of household members	Own/rent the house	TV and/or radio	Alternative water source	Monthly payment for water
Crossroads	5	Own	Both	No	+/- R200
	3	Own	Both	No	+/- R2000
Delft	6	Own	Both	No	Do not pay
	3	Own	Both	No	Max. R900
Dunoon	3	Rent	None	No	Do not pay
	6	Own	Both	No	Do not remember
Joe Slovo Park	5	Rent	Both	No	Do not pay
	7	Own	Both	No	Do not pay
	4	Rent	Both	No	Do not pay
Khayelitsha	4	Own	Both	No	Max. R2000
	3	Rent	Television	No	Do not pay
Kuils River	6	Own	Both	No	+/- R3000
	4	Own	Both	No	+/- R1000
	4	Own	Both	No	+/- R500
Observatory	1	Own	Both	JoJo Tank	Do not remember
	2 to 4	Own	Both	No	R150 – R180
	3	Own	Both	No	Do not remember
	2	Own	Both	JoJo Tank	R140 – R150
Philippi East	2	Own	Both	No	R2000
	3	Own	Both	No	R1000

For exploring households' understanding of the timeline and nature of the actions taken by the CoCT to encourage people to save water, respondents were asked about their awareness of these actions, and when they became of aware of them. To assist respondents in figuring out what happened first and roughly the time of the year, a printed simplified version of the timeline of events was made available. Information contained in this timeline was extracted from the drought timeline published by GreenCape (GreenCape, 2018). This section of the interview also focused on how respondents became aware of the CoCT's actions to encourage water saving, the nature of messages passed to them regarding these actions, and their understanding of these actions in terms of what they entail, their purpose and the groups they target.

To develop an understanding of the meanings and interpretations attached to, and the effectiveness of, the CoCT's actions for household water users, respondents were asked questions centred on whether they think these actions are necessary for the CoCT to implement,

and which of these actions are most important to their respective households in encouraging them to save more water. This part of the interview also focused on what these actions meant for different household water users and the interpretations that people attached to these actions, including how they made them feel.

The next step involved documenting the nature of, and motivations behind, household responses to the CoCT's actions in relation to water use practices. The study used ranking to map out people's perceptions of what activities are the most water intensive, and how these might have changed in response to the actions that the CoCT implemented. Respondents were asked to give a ranking of which of these actions they thought were most effective in encouraging people to save water, and for raising awareness about the water crisis or making people feel more concerned about it. This was based on the ranking of the CoCT's actions from most to least effective. Moreover, the nature of changes in water use practices and inspirations or motivations behind opting for such practices was also explored during the interview.

The last section looked at exploring drivers and motivations for maintaining and/or discontinuing the new behaviour in terms of certain household water use practices in response to the CoCT's actions. To do this, questions were centred on whether households have maintained the new behaviour in terms of using water for certain practices or changed back to the old ways of doing before CoCT's actions for water conservation were in place. This included finding out about things that might have helped households to keep saving water other than going back to their old ways of water use and whether the actions implemented by the CoCT had any influence in this regard or not.

5.2. Data analysis

The interviews were audio recorded and transcribed into Microsoft Word. Quotes were referenced by an anonymous respondent ID number and the area that person lives in, e.g. "Respondent 1, Kuils River". The transcripts were read several times to understand the information in the content and double checked for errors. The first part of the analysis involved the use of NVivo software for coding, to identify patterns or themes from the data. This step was inductive, looking at the data and identifying common themes that emerge. Similarities and differences between the codes were then identified and those that connected were combined. The transcripts were coded for residents' awareness of the CoCT's actions, understanding of the actions mentioned, meanings and interpretations attached to, and the effectiveness of, the CoCT's actions, household responses to the CoCT's actions and drivers

and motivations for maintaining and/or discontinuing the newly adopted water use practices. For the second step, the themes were categorised according to the social practice theory framework, as either falling under materials, competencies and/or meanings. For example, the actions that were mentioned by the respondents as part of what the CoCT did in response to the drought formed part of materials for intervention. The understanding, interpretations and importance of these actions constituted meanings. Then, the nature of responses to the CoCT's actions formed part of competences and new ways of using water. Therefore, the social practice lens was mostly applied when interpreting and analysing the data to understand which materials (CoCT's actions) impacted on the way households use water and how this occurred, the nature of these actions and how households responded to them. Figure 2 below shows a graphical representation of how the social practice framework was used as a guide to analyse the interviews in line with the objectives of this study.

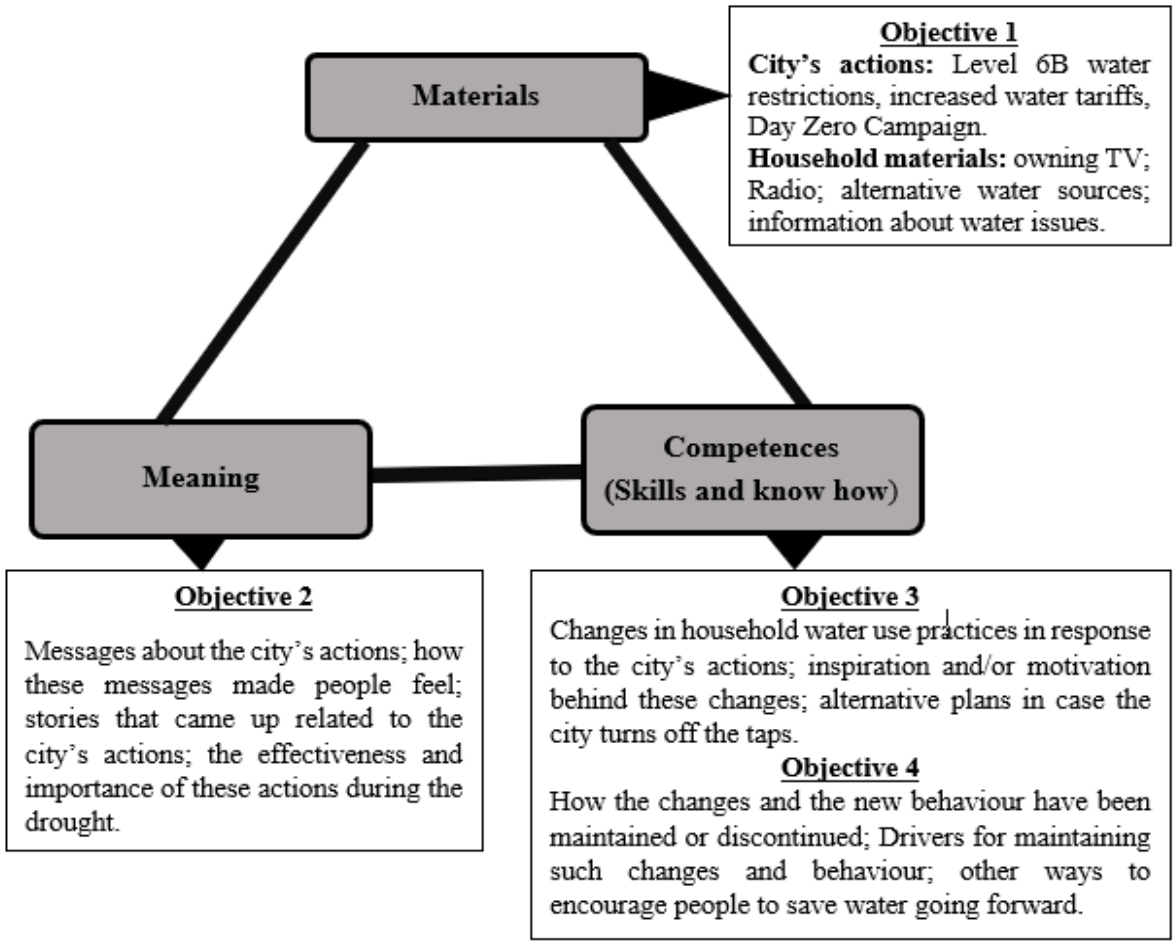

Figure 2: Use of the social practice theory framework as a guide to analyse the data in line with the objectives of the study, modified from Hargreaves (2011).

5.3. Ethical considerations

This research was conducted in accordance with standard ethical procedures of the Science Faculty under the University of Cape Town. The research proposal, interview questions and consent forms were approved by the ethics committee prior the commencement of the research work. Throughout the process of this research, respondents were treated with respect, their participation was completely voluntary, they were allowed to withdraw from the study at any stage if they no longer wanted to participate, they remained anonymous in the analysis and interview recordings, and were allowed to contact the researcher and supervisors for any queries. Before each interview, respondents were given time to read through the consent form and state whether they were willing to participate or not. They also stated whether they agree to be audio recorded or not. Information obtained from the interviews was treated with privacy and confidentiality, only accessed by the researcher and supervisors.

CHAPTER SIX: RESULTS

6.1. CoCT's actions (materials) for managing the water crisis

6.1.1. Understanding of the CoCT's actions, what they were and when they were implemented

6.1.1.1. Water restrictions

Water restrictions were understood by most respondents (18) as a way to limit the use of water in different households to save water during the drought. Some of these respondents associated such limit with a number of litres of water or the amount of water that the CoCT allowed to be used at homes. However, only one stipulated the exact number of litres that each person was allowed to use.

> *"Using less water with a limit of 50 litres per person per day I think. This was when we had to make sure that we always check for leakages."* (Respondent 1, Kuils River)

Other participants viewed water restrictions as means to ban non-essential water use activities that waste water while encouraging water efficient activities. Non-essential water activities included the use of hosepipes to water gardens and washing of cars using clean municipal water while water efficient activities included the use of buckets to carry water when washing cars and a glass of water when brushing teeth.

6.1.1.2. Water tariffs

All respondents (20) viewed water tariffs as payment that people and industries are charged for the water they use.

> *"A water tariff is a monetary water management system used to manage the use of water by households and industries. It is a system that makes households and industries pay for water in relation to the use of water."* (Respondent 1, Philippi)

6.1.1.3. Day Zero communication campaign

The possibility of the occurrence of Day Zero was understood in different ways by the respondents. Some of these ways were either related to the positive gains that the campaign brought and/or losses that the Day Zero could bring if it were to occur. For example, it was viewed by most respondents as the day in which the City of Cape Town was going to run out

of water (14). Others, however, understood it as an awareness and education campaign that sought to bring awareness about the water crisis and educate people about ways in which they could save water during the drought.

> *"[The Day Zero communication campaign] was an initiative that was established to educate people about the water crisis in Cape Town and the different actions that each person needs to do to contribute positively towards saving water."* (Respondent 1, Dunoon)

6.1.1.4. Timeline of the CoCT's actions

The actions taken by the CoCT in response to the drought happened over a period of time. For example, there were several different levels for water restrictions and water tariffs, and the Day Zero communication campaign went on for some time (November 2017 – March 2018). In terms of when the respondents became aware that the CoCT was implementing these actions, some provided the month and the year, and in some instances only the year (Figure 3). Most respondents (17) indicated that the Day Zero communication campaign happened in 2018. This was also the case for water tariffs as 14 respondents added that an increase happened in the same year as the Day Zero communication campaign. For water restrictions, however, most (12) became aware of the restrictions in 2017. Some people specified that level 3 and level 5 water restrictions occurred in September and October (Table 5). Some respondents also noted that level 6 and level 6B water restrictions were put in place in January and February 2018. However, even though respondents provided the levels of water restrictions that the CoCT municipality had established, most did not remember the water use limits that were set under such levels. And four respondents did not recall when the CoCT implemented water restrictions, the level and the water use limit set by restrictions.

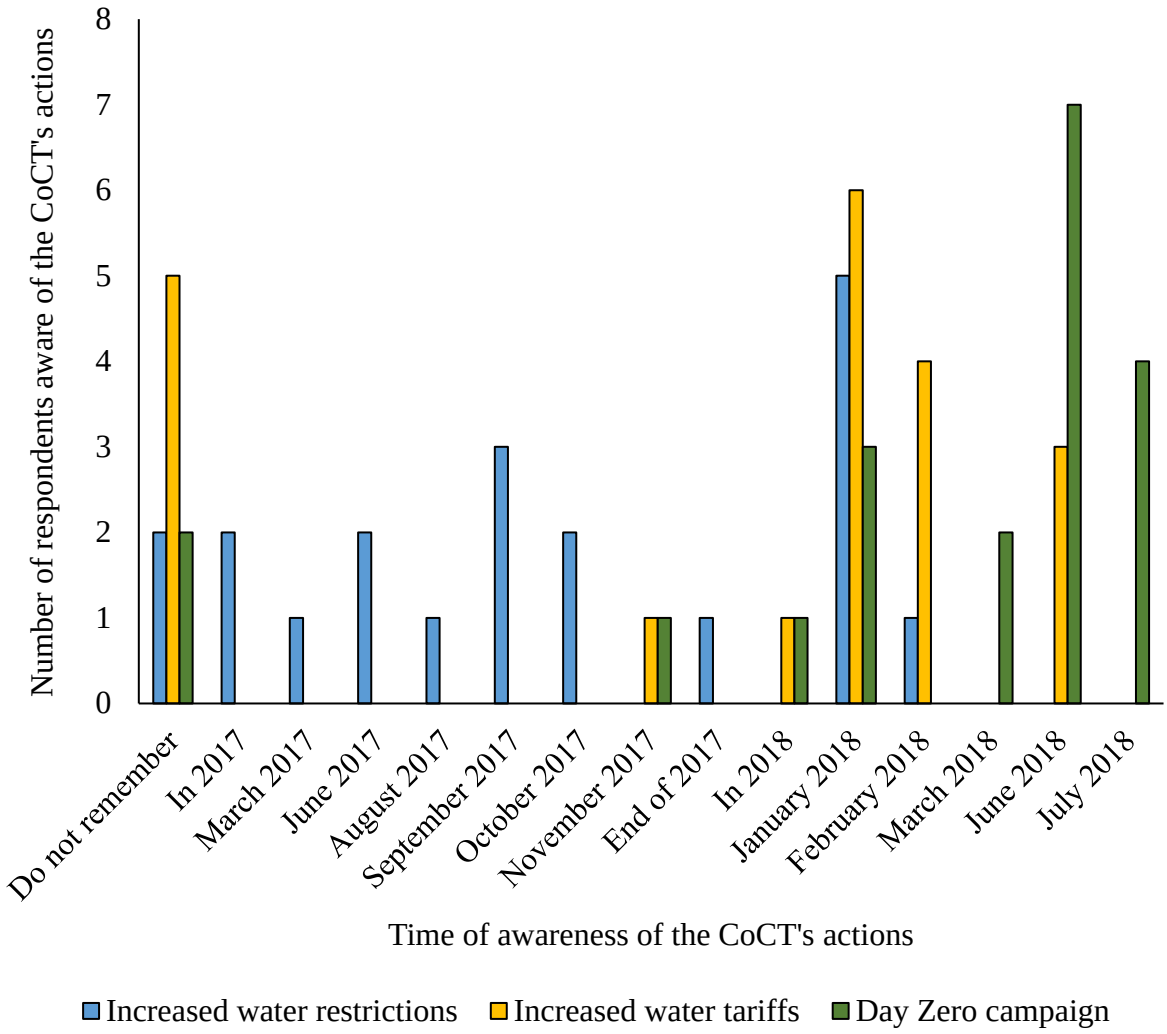

Figure 3: Timeline of when the respondents became aware of the CoCT's actions.

Table 5: Level of water restrictions and water use limit during the time when respondents became aware of the increase (the number inside the brackets indicates the number of respondents. Some respondents remembered when they became aware of the restrictions but did not remember the levels or the limits. Some only recalled the levels and/or limits and did not remember the date).

When participants became aware	Level of water restrictions	Water use limit
March 2017	Do not remember (1)	50 litres per person per day (1)
June 2017	Level 6B (1)	Do not remember (1)
August 2017	Level 4 (1)	100 litres per person per day (1)
September 2017	Level 3 (1)	Do not remember (1)
	Level 5 (2)	Do not remember (2)
October 2017	Level 3 (1)	Do not remember (1)
	Level 5 (1)	Do not remember (1)
In 2017	Level 3 (1)	100 litres per person per day (1)
	Level 5 (1)	70 litres per person per day (1)
January 2018	Level 3 (1)	Do not remember (1)
	Level 6 (2)	50 litres per person per day (2)
	Level 6B (1)	Do not remember (1)
February 2018	Leve 6 (1)	Do not remember (1)
Do not remember	Level 6B (1)	45 litres per person per day (1)

6.2. Meanings, interpretations and effectiveness of the CoCT's actions

6.2.1. CoCT's actions and respondents' interpretation

The findings show that respondents obtained information about CoCT's actions to curb water use from a range of different sources. They viewed social media as the most important sources to make people aware of the Day Zero communication campaign and water restrictions, while posters played an important role for informing them about water tariffs (Figure 4).

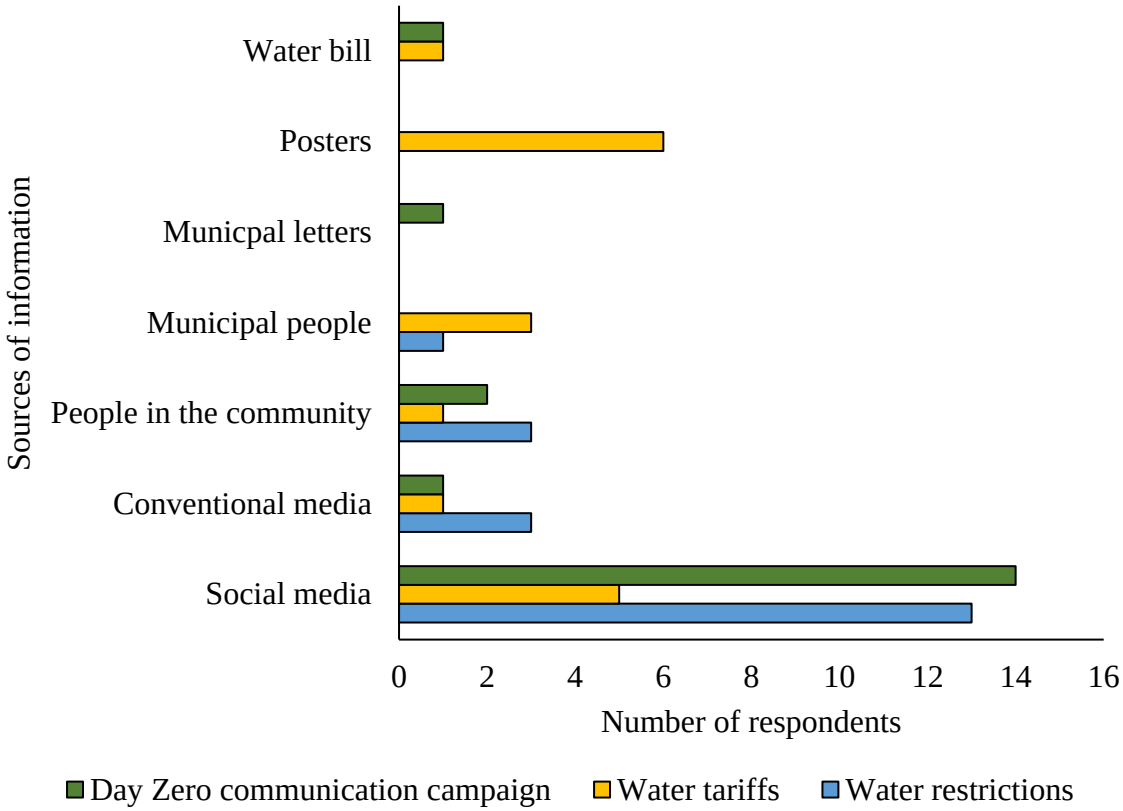

Figure 4: Most important materials or sources that made people aware of the actions taken by the CoCT (some respondents mentioned more than one source).

Respondents had different interpretations of how CoCT actions were presented, which came to influence their decisions. For water restrictions, respondents highlighted that messages included telling people to reduce water use, or to use water within the limits determined by the CoCT and the banning of some water use activities that were not seen as essential as others may be. These messages had an impact on how people viewed, interpreted and felt about water restrictions. Some respondents indicated that they were frustrated due to the lack of clear communication from the CoCT, but also that they felt that an increase in the restrictions was too much and the municipality took too long to respond to the water crisis. Others noted that they understood that water restrictions needed to be ramped up, stating that the drought had put Cape Town in a very bad situation as far as the availability of water was concerned.

> *"I think the level 6B water restrictions were fine because to be quite honest the drought was bad in Cape Town. Taking everything that was said in the*

news and the media, it looked like Day Zero was going to happen."
(Respondent 1, Joe Slovo Park)

For water tariffs, messages were mainly around an increase in the money that people pay for water. Some of these included charging more money to those whose water use goes beyond the limit set by water restrictions, an increase in the water bill and letting people pay according to the amount of water they use. These messages left different impressions in terms of how people interpreted the communication about an increase in water tariffs. While most respondents expressed their disapproval of the way in which this increase was done, others stated that they were fine with how things were handled as far as the increase of water tariffs goes. Those who presented their disapproval cited reasons such as being angry that the CoCT increased water tariffs because even though they tried to save water, the money they were charged was still a lot, so they felt it did not reflect the cost of the actual water use. They also stated that tariffs were unfair because they did not target high water users, and because those who could afford to pay for water could still use water as they wish as long as they settled their water bill. On the other hand, some respondents were happy with the increase in water tariffs and the messages around such increase as they expressed that this forced many people to re-evaluate the way they use water. One respondent felt that it was a right thing to do because the CoCT had to find ways to fund the cost of providing water, despite it being unfair to a certain extent because it did not target high water users.

With the Day Zero communication campaign, the majority of respondents indicated that the main message was that Cape Town was going to run out of water and taps were soon to become completely dry, without having any water coming out of them. This did not leave a positive impression on people; most respondents indicated that they were scared and frustrated by these prospects. One of these respondents was annoyed and viewed the Day Zero communication campaign as a 'scare tactic' used by the government to instil fear on people, forcing them to pay attention to the water crisis. This respondent acknowledged that there was a water shortage but did not agree with this campaign because of the public fear it resulted in. One respondent, however, stated that Day Zero was communicated in a way that encouraged people to work together in finding ways to save water during the water crisis.

The above set of responses regarding how respondents interpreted the three CoCT's actions were common across the different areas socio-economic areas. The frustration concerning water restrictions and disapproval of the increase in water tariffs, as well as the fear that the

Day Zero communication campaign resulted in, came up in both low income and middle-income households during the interviews. This was also the case for the respondents who expressed that they were fine with how things were done regarding the three actions.

Respondents were also asked to share personal stories or anecdotes about the impact of the crisis. While only some did, these narratives document a range of different experiences of what the drought meant for people:

> *"Most people in our community are involved in gardening, especially planting vegetables. They plant vegetables and sell them around to get money to provide for their families. When the restrictions increased people did not have enough water in the taps to water their vegetables. As a result, some vegetables died. Even here at home we suffered from that. When this happened, some people did not have vegetables to sell anymore. It was really bad. Our neighbour's flowers also died because they could not get enough water from the taps to take care of them."* (Respondent 1, Delft)

> *"When the news about Day Zero started to spread all over, people started collecting as much water as possible from the [private] houses with taps outside using the 5 Litre water bottles. We collected those and stored them for just in case Day Zero happens. This caused some tension between some people because if you have many water bottles to collect the water some people complained about that."* (Respondent 1, Delft)

> *"Some people said they had received letters threatening them that their taps would be completely turned off if they do not pay the required amount of money immediately. That is really bad, when you cut off the water, where do you expect people to go? One lady called me panicking, saying that she has a problem. I was really scared, thinking maybe her husband passed away since he was ill around that time. She was calling to ask for money because the water was going to be turned off if she does not pay the money. I even drove to her place because she was really panicking."* (Respondent 1, Kuils River)

As these examples show, the water crisis threatened people's livelihoods, created tensions in communities, and distressing rumours and uncertainty regarding potential loss of access to

water. This demonstrates the range of pressures created in a population beyond the most immediate challenge to conserve water.

6.2.2. Effectiveness of CoCT's actions to encourage sustainable household water use practices

Interviews revealed that most respondents considered increased water restrictions to be the most effective way to encourage people to save water (Figure 5). For this, respondents stated that the limiting of water use to a certain amount of litres, which was the main message around water restrictions, helped in providing information about how much water households should use during the water crisis. Households, therefore, incorporated such information onto their water use practices.

Of the three CoCT actions studied here, respondents viewed the Day Zero communication campaign as most effective for raising awareness about the water crisis (Figure 5). Some indicated that the fear of running out of water made them feel concerned about the crisis. Others saw this campaign as an action that brought about necessary and useful information about the water crisis, thereby creating awareness. This gave them an opportunity to learn about the nature of the crisis and ways in which people could help manage it by saving water in their households.

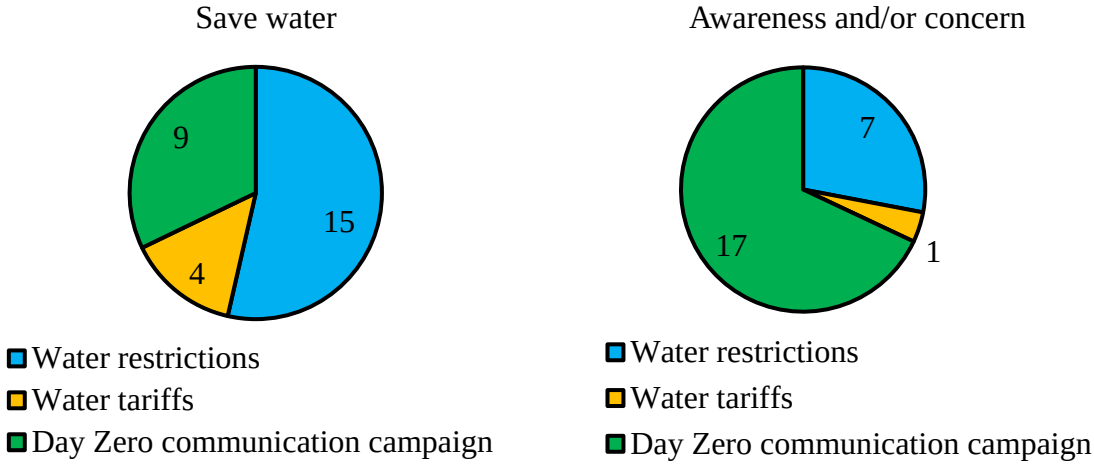

Figure 5: Most respondents saw water restrictions as most effective for encouraging them to save water. For raising awareness and concern about the drought, most viewed the Day Zero communication campaign as most effective.

6.3. Competences (Skills and know how)

6.3.1. Changes in household water use practices in response to the CoCT's actions

Most respondents stated that they have changed the way they use water around their households. The majority (12/20) mentioned toilet flushing as using the most water in their households before the crisis. The most common change introduced (by 14/20 respondents) was using greywater for flushing. This was mentioned by the three respondents from low income households and 11 respondents in the middle-income category. Consequently, at the time of the interviews flushing was no longer seen as using the most water, except for one respondent who still considered it to be using most water in their household because they had not established ways to change from using clean municipal water for it.

> "*We have two buckets in the bathroom that we use to collect water while showering and use that water to flush the toilet*." (Respondent 2, Kuils River)

> *"Even though we have made changes, flushing the toilet has not changed much because we do not have other ways we can use to stop using municipal water for it*." (Respondent 2, Joe Slovo Park)

After flushing, bathing (11/20) and showering (9/20) were seen as using the most water before the crisis. Here, 8 of 20 respondents reported having limited these activities in their households. This was mainly based on taking short showers and using small amount of water when bathing. Respondents indicated that the changes made in the said water use practices were mainly prompted by an increase in water restrictions and the Day Zero communication campaign, and not so much by increased water tariffs.

6.3.2. Drivers and motivations for maintaining and/or discontinuing the new behaviour

While almost all the respondents indicated that they have been able to maintain the changes they made and continue with the new behaviour, one mentioned that they have changed back to using water as they did before the CoCT enforced its actions to curb water demand. This respondent cited the discontinuation of the Day Zero communication campaign as the reason for changing back.

> *"We changed back when we heard that Day Zero was not going to happen. We flush the toilet and use the bath now."* (Respondent 1, Khayelitsha)

For those who maintained the changes in water use practices, motivations included trying to avoid water cuts by using water within the water restrictions and trying to make a difference as good and responsible citizens. For some, the Day Zero communication campaign was a great initiative in terms of precipitating out information necessary to motivate people and encourage positive action. Moreover, six respondents stated that their motivations came from understanding how serious the drought was, which made them pay attention to it and think of ways to use less water around their households.

> *"We are conscious of the fact that the drought is a very serious issue, not in Cape Town only but also some parts of the world. Learning about it and having knowledge of how serious it is, encouraged us to maintain the changes."* (Respondent 4, Observatory)

CHAPTER SEVEN: DISCUSSION

The use of social practice theory (SPT) in analysing the impact and effectiveness of the City of Cape Town's price and non-price mechanisms on household water use practices provides the opportunity to understand certain aspects of behaviour change. This is because the SPT has been regarded as an important gateway for interdisciplinary thinking, which is essential when dealing with large scale and complex behavioural problems (Marsden et al., 2014; Spotswood et al., 2015). Through an analysis of the problem (Spotswood et al., 2015) (i.e. unsustainable water use practices), SPT helps to identify a range of opportunities to enable change (Rettie, Burchell & Riley, 2012). These opportunities are based on the principle of social practice, which proposes that links between interrelated elements of practice (materials, meanings and competences) need to be broken or challenged for the change in practice to occur (Shove & Pantzar, 2005). Thus, a range of interventions, policy and infrastructure may be needed to foster reconfiguration of consumption practices (Spotswood et al., 2015). In the case of Cape Town, water restrictions, an increase in water tariffs and the Day Zero communication campaign constitute materials for interventions in encouraging people to save water in their households. To gain insights about the impact and effectiveness of these mechanisms, there is a need to understand how people respond to them in terms of residential water use practices. This requires understanding materials, meanings and competences (skills and know how) that people have, which constitute elements of social practice.

It can be argued that the way communication around the CoCT's actions was done and how they were implemented is important to consider as this influenced, not only how people perceived these actions, but also how they responded to them. The results show that when people became aware, and understood the nature, of the CoCT's actions, they reconfigured materials used when performing certain water use practices and meanings emerged in terms of what was viewed as possible options to save water when carrying out these practices. According to Ward (2005) and Hargreaves (2011), as meanings emerge and unfold, practices change because people do not only contest practices that already exist but also reconstruct materials, meanings and competences into ways that respond to the new circumstances. In Cape Town such circumstances exist in terms of the actions implemented by the CoCT in response to the water crisis, where certain water uses have been banned and there is a limit on how much water households can use. These were understood and interpreted differently, thereby leaving different impressions on people. The results reveal that messages around water restrictions such as the banning of certain water use activities left some people frustrated because they felt that

the CoCT took too long to respond to the water crisis, while others thought restrictions were fine because Cape Town was in a bad situation due to the drought. Similarly, while some respondents expressed their disapproval of an increase in water tariffs, others felt that it was a good way of funding the cost of providing water to the citizens. Moreover, while some saw the communication around Day Zero as a 'scare tactic' because it resulted in fear for many, others maintained that it was an educative campaign during the water crisis. This shows that the way the CoCT's actions were communicated, including the messages passed onto residents, had an impact on how people perceived and felt about these actions.

Drawing on the literature, it can be argued that there is no clear consensus among researchers as to whether price or non-price mechanisms to support water demand management are best suited to managing residential water consumption. This also extends to the impact and effectiveness of these mechanisms as some authors argue for price and others for non-price mechanisms (Herbertson & Tate, 2001; Kenney et al., 2008; Olmstead & Stavis, 2009; Araral & Wang, 2013; Reynaud, 2013; Asci, Borisova & Dukes, 2015; Stavenhagen, Buurman & Tortajada, 2018). It is, therefore, likely that the effect depends on the context and recipient of the intervention. Moreover, qualitative studies of this nature are important because they help understand nuance and apparent contradictions in more quantitative data and can help answer the "why?" behind other findings.

The results from this study suggest that most respondents perceive non-price mechanisms as being considerably more effective than price mechanisms. This is both the case for raising awareness, where the Day Zero communication campaign was ranked highest, and for water-saving behaviour, where the water restrictions were ranked highest. For this, most respondents claim that the main issue is that high water users can still use more water in their households if they can afford to settle the water bill at the end of the month. In such instances, their water supply does not get cut off because they are able to pay for their consumption. However, the drought created an exception, where the CoCT forced those using over 20 kL/month to reduce consumption by installing water management devices limiting their use to 10.5 kL/month. Over time devices got rolled out to households using less than 20 kL/month too but the strategy around who was targeted was not clear (Booysen, Visser & Burger, 2019). To encourage water conservation behaviour through price mechanisms, some authors propose that marginal-cost pricing of water is an option but there are still debates around its effectiveness. While some argue that it is an effective tool to manage water consumption because consumers are able to adjust water use practices in response to marginal prices (Herbertson & Tate, 2001; Kenney et

al., 2008; Olmstead & Stavis, 2009; Araral & Wang, 2013; Asci, Borisova & Dukes, 2015; Stavenhagen, Buurman & Tortajada, 2018), others argue that marginal prices are not effective because residential water demand does not always change in response to changes in price (Gaudin, Griffin & Sickles, 2001; Garcia & Reynaud, 2004; Reynaud, 2013). Looking at water demand management strategies in Spain, Tortajada et al. (2019) found that for price mechanisms to work effectively, especially in the context of water users who are high income earners, water consumption would need to be extraordinarily high for the price of water to have a significant impact on the household income.

Among other users, the lack of motivation to respond to the water tariffs may be because people do not trust that the money they pay reflects the amount of water they have used, as some respondents indicated that even though they saved water their water bill was still high. This is not surprising because issues involving trust, especially towards water meter readings and the water bill, have been noted in other studies. As discussed earlier, in Pietermaritzburg, KwaZulu-Natal, Smith & Green (2006) found that meter readings are one of the factors that have led to confusion and distrust towards the municipality. This is because people had no understanding of how the water meter works, did not trust the work of the person responsible for reading the meter and had problems checking whether the amount of money they were paying for water was realistic and true reflection of their usage (Smith & Green, 2006). Studying the effect of price and behavioural signals for encouraging water conservation in the UK, Lu, Deller & Hviid (2017) reported that households are sometimes put in vulnerable situations where the amount of money in the water bill is based on estimates rather than the actual meter readings. This then leads to confusion, especially when the water tariffs increase.

Overall, the respondents consider non-price mechanisms as better enablers of water conservation behaviour. They particularly perceive water restrictions as having more effect in encouraging people to use water efficiently in their households. Respondents claimed that this was mainly because water restrictions provided clear information about how much water households were supposed to use per day. This result confirms the effectiveness of water restrictions on household water use practices, especially during the drought period. Based on previous research - in Iowa (Lee & Warren, 1981), Texas (Shaw & Maidment, 1988), Southern California (Shaw, Henderson & Cardona, 1992), Colorado (Kenney, Klein & Clark, 2004), Los Angeles, California (Mini, Hogue & Pincetl, 2014) and Australia (Lindsay & Supski, 2017), which analysed the impact of water restrictions on water consumption in response to drought, it is not surprising that this study found water restrictions to have more effect in getting people

to save water in their homes. However, it is difficult to directly compare this result with findings from these studies because these studies were based on quantifying all municipal water consumption, not only water use by single-family residences, except for Mini, Hogue & Pincetl (2014) and Lindsay & Supski (2017). While these studies are useful as they provide empirical evidence on the effectiveness of water restrictions to curb water consumption based on quantitative data, they do not explain why and how water use practices change. Studying how household water use practices changed during the drought, using water restrictions as a 'material' for intervention, Lindsay & Supski (2017) found that in Brisbane and Melbourne participants reported that water restrictions played a significant role because they made households change the way they use water, shifting towards more sustainable water use practices. Quantifying the impact of an increase in water restrictions on water use by single-family residences across Los Angeles, Mini, Hogue & Pincetl (2014) found that mandatory restrictions resulted in 19% to 23% water use savings in the Spring and Summer periods. Therefore, looking at results from the previous research, which is largely based on quantifying the impacts and effectiveness of water restrictions on water use, and the findings from this study, which were based on a qualitative approach, water restrictions seem to be an enabler of water conservation behaviour at a household level. This means that people respond more to an increase in water restrictions than in water tariffs.

Education and awareness campaigns are one of the most important aspects that have been considered under non-price mechanisms by city governments and in some studies (Martínez-Espiñeira & García-Valiñas, 2013; Dascher, Kang & Hustvedt, 2014; Tortajada et al., 2019). These campaigns aim to play an important role in educating people about, encouraging and motivating them to pay attention to, situations such as water crises and possible ways to survive such crises. Tortajada et al. (2019) posit that an increase in public awareness campaigns is potentially the major factor for explaining the conservation of water in homes. The results from the Cape Town context show that most respondents considered the Day Zero communication campaign to be the most effective action for raising awareness about the water crisis. Some respondents explained that this campaign resulted in fear because people feared that the city would run out of water and such fear brought about concern about the water crisis. Others claimed that this campaign gave people an opportunity to learn about and engage with the context of the crisis by providing them with necessary and useful information. Some of the previous studies that have reported on education and awareness raising campaigns have also found that these campaigns work effectively in encouraging water saving around homes and

raising awareness (Martínez-Espiñeira & García-Valiñas, 2013; Tortajada et al., 2019). Studying factors that determine the adoption of water conservation habits and water-saving technologies by households in Spain, Martínez-Espiñeira & García-Valiñas (2013) found that education and awareness raising campaigns result in strong positive effect on households' decisions to adopt water conservation habits and buy water-saving technologies. Most recently, Tortajada et al. (2019) showed that education and awareness raising campaigns, which aimed at encouraging more efficient water use, as well as targeted campaigns for promoting adoption of water-saving technologies in Spain, were most favored by the participants, thereby yielding tangible results compared to other measures. This suggests that the way a campaign is communicated and implemented can lead to different interpretations by civil society. Therefore, depending on how people interpret it, a campaign can also be perceived as either a positive or negative action for encouraging water conservation. In the case of Cape Town drought, the Day Zero communication campaign managed to raise awareness even though it was interpreted differently by the respondents, with some calling it a 'scare tactic' while others saw it as a way of educating people about the crisis.

Having understood and interpreted the nature of the CoCT's actions for managing the water crisis, households had to think of ways in which to incorporate these actions into their water use practices. Ultimately, households had to either continue or discontinue certain water use practices and, in some cases, formulate or introduce new ways of doing in response to these actions. This required people's competences and skills to be able to adjust to the new circumstances. The results in this study show that most of the changes made by households in water use practices were prompted by water restrictions and the Day Zero communication campaign, and less so by an increase in water tariffs. This is an important finding as it feeds into the debate around the (in)effectiveness of water tariffs and (in)elasticity of residential water demand to price (Araral & Wang, 2013; Reynaud, 2013; Stavenhagen, Buurman & Tortajada, 2018). The results from the Cape Town case suggest that price mechanisms do not help much in encouraging people to change their water use practices and raising awareness about the crisis, as compared to non-price mechanisms such as water restrictions and education and awareness campaigns. Households changed their behaviour during the drought in Cape Town due to water restrictions and the Day Zero communication campaign. Change in behaviour mostly occurred in household water use practices that are thought to be difficult to change when water tariffs are introduced, such as those related to personal hygiene and food preparation (Arbués & Villanúa, 2006; Olmstead & Stavis, 2009). From a social practice

perspective, this is not surprising because in most households the primary driver of water use has been based on the desire to achieve cleanliness (Shove, 2003b). Water use practices such as showering, bathing, flushing and doing dishes and laundry constitute the reproduction of cleanliness within households. With these practices, people make means of maintaining the societal standards of what is acceptable for cleanliness, even when the provision of a resource (water) has been interrupted (Shove, 2003c), such as during water crises. With disruptions in water supply and CoCT's actions in place, particularly water restrictions and the Day Zero communication campaign, households were able to change their water use practices and learn new ways of doing to keep clean. These responses suggest changes in materials, meanings and competences within households due to the CoCT's actions for curbing water demand during the drought. For example, water use practices such as flushing the toilet using municipal water were broken and new practices formed where people started using grey water to flush the toilet. A reconfiguration of practice occurred when households stopped taking long showers. Transformation in bathing took place when households started using round plastic wash basins or tubs instead of bath tubs, so that they could measure the amount of water used using a bucket and collect it for use when flushing the toilet. As such, materials for carrying out these practices changed, with the use of buckets for measuring water, collecting grey water for flushing the toilet, and the use of round plastic basins for bathing, emerging as new materials introduced to the new ways of doing. This also presents a shift in meanings as it can be argued that flushing the toilet using grey water, taking short showers and using round plastic basins to bath, were no longer only seen as places to maintain personal hygiene but also as places where water can be saved most.

Research on domestic water demand shows that consumption at household level is also influenced by numerous factors such as settlement location, socio-economic and demographic variables and environmental variables such as temperature and precipitation (Jones & Morris, 1984; Jorgensen, Graymore & O'Toole, 2009; Shan et al., 2015). These factors can also affect people's perceptions of, and the nature of responses to, the more policy level interventions. The three actions studied here are some of the policy variables that were prioritised by the CoCT for curbing household water demand during the drought (CoCT, 2018; Ziervogel, 2019). Although different socio-economic areas were studied, the focus was on bringing out perceptions across the range of socio-economic areas. Even though this was the case, the findings in this study suggest that there were some commonalities in responses from the interviews across the different socio-economic and demographic contexts. These

commonalities were present in the way respondents understood and interpreted the CoCT's actions and how they responded to these actions in relation to their water use practices. For example, the respondents' understandings of the three CoCT's actions were almost unanimous across the different areas. This was evident when all respondents understood water tariffs as payment for municipal water, 18 referring to water restrictions as a way of limiting water use and 14 viewing Day Zero as the day Cape Town was going to run out of water.

Shan et al. (2015) argue that the association of household income and the ability to engage in water saving behaviours is sometimes ambiguous. For example, the Independent Pricing and Regulatory Tribunal (IPART) in Sydney reported that high income can enable households to purchase more efficient appliances (water-saving appliances) but reluctance to change water use practices or modify habits sometimes negates this saving (IPART, 2011). By contrast, low income households are arguably less likely to purchase water-saving technologies but may still be able to engage in money-saving habits which could subsequently lead to the adoption of more efficient water use practices, such as only using a washing machine when there is a full load (Shan et al., 2015). Results from this study suggest that households from both income categories (low income and middle-income) changed their water use practices to reduce consumption and the changes introduced (such as using greywater for flushing) were common across the range of socio-economic areas studied. These findings are consistent with results from some of the studies on people's perceptions of water consumption and factors that influence water conservation behaviours (Gregory & Di Leo, 2003; Gilg & Barr, 2006; Beal, Stewart & Fielding, 2013; Fan et al., 2014). These studies reported that low and middle-income households often use less water and adopt water saving practices compared to high income earners. While residents with high income and education levels have been found to use more water than other groups due to the presence of appliances that require more water for operation (i.e. washing machines) (Fan et al., 2014), it has also been noted that high income enables households to purchase more efficient water appliances (Beal, Stewart & Fielding, 2013). In this study, none of the households included were from the high-income category.

CHAPTER EIGHT: CONCLUSION AND RECOMMENDATIONS

8.1. Conclusions

The occurrence of water crises in many parts of the world raises the need to consider more efficient and sustainable consumption of water resources (Tortajada et al., 2019). To encourage such, many cities have prioritised water demand management strategies, which are based on price and non-price mechanisms. To understand the impact and effectiveness of these mechanisms, there is a need to understand how people respond to them. This requires understanding materials, meanings and competences (skills and know how) that people have, which constitute elements of social practice.

This research focused on price mechanisms based on water tariffs and two of the non-price mechanisms (water restrictions and the Day Zero communication campaign) implemented by the CoCT in response to the drought that were intended to get residents to reduce their water use. The study focused on exploring meanings and interpretations that household water users attributed to the actions the CoCT used and how these actions might have impacted household water use practices. A version of social practice theory was used as a lens to understand how respondents interpreted and responded to these mechanisms when it comes residential water use practices. This allowed for the demonstration of which of the CoCT's actions were more effective in encouraging sustainable water use practices.

The results show that respondents understood and interpreted the CoCT's actions differently and this left different impressions on them. This was evident when Day Zero was interpreted as a scare tactic and an educative campaign, water restrictions resulting in frustration for some, and others being angry because they thought water tariffs were unfair. Based on this finding, it is concluded that the way communication around the CoCT's water management actions was done and how they were implemented influenced, not only how people perceived these actions, but also how they responded to them. The messages passed onto residents by various information sources about actions for curbing water demand have an impact on how people engage with these actions. Therefore, city governments need to carefully consider how communication about the water crises and WDM is done, especially when engaging the public.

Regarding the efficacy of the CoCT's actions, the findings suggest that respondents consider non-price mechanisms as being considerably more effective than price mechanisms. This is

both the case for raising awareness, where the Day Zero communication campaign was ranked highest, and for water-saving behaviour, where the water restrictions were ranked highest. This study, therefore, concludes that non-price mechanisms have much more effect in encouraging people to save water around their households and creating awareness about the water crises. As such, cities need to focus more on non-price mechanisms because people respond more to them, as opposed to price mechanisms.

This study shows that the Day Zero communication campaign helped in raising awareness about the water crisis in Cape Town. It managed to keep respondents updated about the drought while also communicating possible ways to help deal with it. This research suggests that awareness raising campaigns play an important role in educating people about, encouraging and motivating them to pay attention to the water crisis and possible ways to help manage it. However, it can be argued that targeted campaigns may not always have long term impacts because some people tend to forget about them in the long run. When they are discontinued, people often go back to using water as they did before such campaigns were in place.

Overall, given the debate on the effectiveness of WDM strategies which is widely documented in the literature, this study argues that the impact of these strategies is likely dependent on the context and the recipient. This research shows that in the Cape Town context non-price mechanisms had more impact on households, thereby encouraging them to save water during the drought. The main contribution is that, compared to most of the literature which provides empirical evidence on the effectiveness of WDM strategies based on quantitative data, this study explains how and why household water use practices change in response to these measures. This is important for research and understanding how residents engage with WDM.

8.2. Summary

This research aimed at exploring how different drought responses impacted household water use practices in Cape Town. To fulfil this aim, the study addressed four objectives.

Objective one looked at exploring households' understanding of the CoCT's actions, and what they were and when they were implemented. The study revealed that most respondents understood what water restrictions, water tariffs and the Day Zero communication campaign were. Water restrictions were mainly understood as way of limiting the use of water in different households to save water during the drought. Water tariffs were referred to as a payment that people and industries are charged for the water they use. The Day Zero communication campaign was mainly understood as the day in which Cape Town was going to run out of water.

Most respondents became aware of the water restrictions in 2017 and the Day Zero communication campaign and water tariffs in 2018.

The second objective focused on developing an understanding of the meanings and interpretations attached to, and the effectiveness of, the CoCT's actions for household water users. Results showed that price mechanisms (water tariffs) were considered to be ineffective and did not encourage people to save water. Non-price mechanisms (water restrictions and Day Zero communication campaign) were seen as having more impact on respondents, encouraging water conservation behaviour. The main concern presented by respondents regarding water tariffs was that they were unfair because they did not target high water users and those who can afford to pay for water could still use water as they wish as long as they settle the water bill. The results confirm the effectiveness of water restrictions to encourage people to save water, and that of the Day Zero communication campaign to raise awareness and educate people about the water crisis in Cape Town.

Objective three looked at documenting the nature of, and motivations behind, household responses (in terms of how they use water) to the CoCT's actions. The study revealed that households changed their behaviour during the drought in Cape Town due to water restrictions and the Day Zero communication campaign. Change in behaviour mostly occurred in household water use practices that are thought to be difficult to change when WDM strategies are in place, such as those related to personal hygiene and food preparation. With disruptions in water supply and CoCT's actions in place, particularly water restrictions and the Day Zero communication campaign, households were able to change their water use practices and learn new ways of doing to keep clean. These responses suggested changes in materials, meanings and competences within households due to the CoCT's actions.

The fourth objective explored drivers and motivations for maintaining and/or discontinuing the new behaviour in terms of certain water use practices. The results showed that while most respondents have been able to maintain the changes they made and continue with the new behaviours, one changed back to using water as they did before the CoCT implemented the actions. For those who maintained the changes in water use practices, drivers included trying to avoid water cuts and using water within the water limits and understanding that the drought is a serious issue that needs proper attention. For the one who have changed back, the discontinuation of the Day Zero communication campaign was the main reason for changing back.

8.3. Recommendations

Based on this research, the following recommendations are provided for future research and work on price and non-price mechanisms, especially by city governments.

- The CoCT needs to consider what it wants to achieve with each of its different interventions, since they all have side effects. Water tariffs might hit the poorer more, water restrictions might be confusing or misunderstood by people and scare campaigns that keep getting postponed and eventually discontinued might create public distrust towards the CoCT in the future.
- The CoCT needs to focus more on non-price mechanisms because people respond more to them, as opposed to price mechanisms.
- It is important that the actions are clearly communicated, and information is made available to the public. Approaches that are reactive and not clearly communicated, only acting when the crisis occurs, may come across as top down, forcing people to respond without having a clear understanding of these measures. This may result in confusion and misinterpretation of what the CoCT is trying to achieve as was seen in the case of price mechanisms.
- To encourage long term water saving behaviour, there should be constant education and awareness raising campaigns that keep people updated about water related issues. Targeted education and awareness raising campaigns do not always have long term impacts because some people tend to forget about them in the long run. When these campaigns are over/discontinued, people go back to using water as they did before the interventions were in place.
- The CoCT should partner with local groups that represent different areas or administrative divisions and water groups such as water warriors to emphasize more on public engagement. Building public trust and engagement with residents is important as this ensures that people and their concerns are considered in the water supply system.

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APPENDIX 1: INTERVIEW SCHEDULE

Interview questions

1. What is the total number of people living in your household, including you?

2. Do you own or rent the house?

3. Does your household own a television, radio or both?

4. How does your household usually receive information or communication from the city government about issues related to water in Cape Town?

5. Besides communication from the city government, is there any other way that your household receives information about or becomes aware of the water issues in Cape Town?

6. Apart from municipal water, does your household have any alternative water source? If yes, what is it and when was it installed?

7. (If alternative water source is installed) What made you think of installing an alternative water source?

8. Who pays for water in your household? How much do you pay a month?

9. How do you think the City of Cape Town should fund the costs of providing water to its citizens? If the interviewee does not know or understand: Do you think the current water tariffs are appropriate? Should income matter for how much people pay for water in Cape Town? Should high water users pay the same as those using less?

10. As far as you know, what steps or actions has the City of Cape Town taken to encourage people to save water? (For this question, people were asked first to list any steps they can think of, and after this or if they do not list any, the timeline was used to prompt them for further actions from City of Cape Town).

11. This study is interested in **increased water tariffs**, **water restrictions** and the **Day Zero communication campaign**. Can you tell me more about what you understand as water restrictions, water tariffs and the Day Zero communication campaign?

Water restrictions:

Water tariffs:

Day Zero Campaign:

In Cape Town all of these actions happened either in several instances, or over a period of time. For example, there were several different levels for water restrictions and water tariffs, and the Day Zero communication campaign went on for some time.

12. Do you remember when you became aware of when the City of Cape Town increased water restrictions and water tariffs, and officially adopted the Day Zero communication campaign in response to the drought? In which order did you become aware of these actions? In which order do you think the city undertook these actions?

Question	Increased water restrictions	Increased water tariffs	Day Zero communication campaign
When			
Order	Respondent: City of Cape Town:	Respondent: City of Cape Town:	Respondent: City of Cape Town:

13. What level were the water restrictions when you became aware? How much were you supposed to cut your water use?

14. What was the most important thing that made you become aware that the City of Cape Town was undertaking each of these actions?

Increased water restrictions:

Increased water tariffs:

Day Zero communication campaign:

15. What did [insert answers from question 14] say about [insert each action]?

Increased water restrictions:

Increased water tariffs:

Day Zero communication campaign:

16. How did the messages around increased water restrictions/increased water tariffs/adoption of Day Zero communication campaign make you feel?

Increased water restrictions:

Increased water tariffs:

Day Zero communication campaign:

17. What do you think the City of Cape Town's intentions were for introducing water restrictions? What do you think the City of Cape Town was hoping to achieve?

18. When reflecting on the timeline or the order in which you became aware of the actions that the City of Cape Town undertook and what was said about them, are there any stories that came up about each of these actions that left an impression on you? Whether through conversations with friends, through media or something that happened around the household etc. If yes, could you please share those?

Increased water restrictions:

Increased water tariffs:

Day Zero communication campaign:

19. In general, which of the three City of Cape Town's actions do you think were more effective a) in encouraging people to undertake more effective ways to save water? And b) for raising awareness about the water crisis or making people feel concerned about it?

Question	Increased water restrictions	Increased water tariffs	Day Zero communication campaign
Save water	Rank:	Rank:	Rank:
	Why?	Why?	Why?
Awareness or feeling concerned	Rank:	Rank:	Rank:
	Why?	Why?	Why?

20. Have you changed the way you use water in response to the actions (water tariffs, water restrictions and Day Zero campaign) that the City of Cape Town has taken?

If no, why?

Did you make any plans for if the City of Cape Town should turn off the taps?

If yes, please tell me more about the nature of these changes and how you went about doing them? What order, why? Where did you get information about these changes? Which of the actions taken by the City of Cape Town prompted the change? Why that/them?

Changes made	Order	Sources of information	Why that order?	City of Cape Town's actions
				Restrictions, tariffs, day zero

21. What inspired you to make these changes apart from what the City of Cape Town was doing?

22. Besides the specific changes that you made in terms of how you use water, did you make any alternative plans should the restrictions and tariffs become extremely high or the City of Cape Town turn off the taps? If yes, what were those alternative plans?

23. Do you know how much water your household used before the drought? How much does it use now? In future, how much water would you want your household to use per day?

Before the drought:

Water use now:

In future:

24. What does your household use most water for? Please tick water use activities relevant to your household in the table below.
Off the activities you ticked, please rank from most water intensive activity to the least, with 1 being most water intensive and 5 being the least intensive, before and after the drought.

Tick	Water use activity	Rank of water use activities			
		Municipal water		Alternative water source	
		Before drought	*After the drought*	*Before drought*	*After the brought*
	Showering				
	Bathing				
	Brushing teeth				
	Toilet				
	Dishes and laundry				
	Cooking				
	Drinking				
	Swimming pool				
	Garden				
	Washing the car				
	Other				

25. If water restrictions were to drop to level 3, would your household use as much water as it did during level 6B water restrictions or would you change? And why? How much water do you think you would use?

26. Looking at the changes you made in terms of how you use water, have you been able to maintain these changes and the new behaviour, or have you changed back?

If you have changed back, what made you to change, and when?

If you still continue with the changes you made, what has helped you continue your new behaviour?

Can you tell me more about your new behaviour? Have you made any changes to your lifestyle that the City of Cape Town was not asking you to do, but that was still because of the water crisis?

27. Do you think people should still care about saving water, and why or why not?

28. Do you think Level 6B water restrictions should be in place permanently or under certain conditions? If permanently, why do you think so? And if only under certain conditions, what do you think those conditions should be?

29. Do you think high water tariffs should always be linked to water restrictions or be separated from them and, why or why?

30. Do you think it is important to have a constant awareness raising campaign to encourage people to use water effectively or just have targeted awareness campaigns? Why?

31. Reflecting on the actions that the City of Cape Town undertook, what are some of the other ways that you think the municipality should have in place to encourage people to use water effectively going forward?

32. Looking at the changes you made and how you got information about them, was there any information that would have helped you understand things better or make other changes?